

WHAT IS CLAIMED IS:

1. A method of manufacturing a semiconductor device, comprising steps of:
  - adding a metal element to a semiconductor film having an amorphous structure;
  - 5 crystallizing the semiconductor film having an amorphous structure to form a semiconductor film having a crystalline structure;
  - selectively adding a rare gas element to the semiconductor film having a crystalline structure to form an impurity region;
  - gettering the metal element to the impurity region to selectively remove  
10 or reduce the metal element in the semiconductor film having a crystalline structure; and
  - removing the impurity region.
2. A method according to claim 1, wherein one kind or a plurality of kinds of  
15 elements selected from the group consisting of H, H<sub>2</sub>, O, O<sub>2</sub>, and P are added in addition to the rare gas element.
3. A method according to claim 1, wherein the selectively adding a rare gas  
element is conducted in an atmosphere containing a rare gas element and water  
20 vapor.
4. A method according to claim 1, further comprising a step of irradiating the semiconductor film with strong light or laser light from a front surface or a reverse surface to activate the impurity element after the removing the impurity region.

5. A method according to claim 1, further comprising a step of oxidizing a surface of the semiconductor film having a crystalline structure with a solution containing ozone after the crystallizing.

5 6. A method according to claim 1, wherein the crystallizing is conducted by heat treatment.

7. A method according to claim 1, wherein the crystallizing is conducted by irradiation of the semiconductor film having an amorphous structure with strong  
10 light.

8. A method according to claim 7, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure  
15 mercury lamp.

9. A method according to claim 1, wherein the crystallizing is conducted by heat treatment and irradiation of the semiconductor film having an amorphous structure with strong light.

20 10. A method according to claim 9, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

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11. A method according to claim 1, wherein the gettering is conducted by heat treatment.

12. A method according to claim 1, wherein the gettering is conducted by  
5 irradiation of the semiconductor film with strong light.

13. A method according to claim 12, wherein the strong light is emitted from  
a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a  
xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure  
10 mercury lamp.

14. A method according to claim 1, wherein the gettering is conducted by heat  
treatment and irradiation of the semiconductor film with strong light.

15 15. A method according to claim 14, wherein the strong light is emitted from  
a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a  
xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure  
mercury lamp.

20 16. A A method according to claim 1, wherein the metal element is one kind  
or a plurality of kinds of elements selected from the group consisting of Fe, Ni, Co, Ru,  
Rh, Pd, Os, Ir, Pt, Cu, and Au.

17. A method according to claim 1, wherein the rare gas element is one kind  
25 or a plurality of kinds of elements selected from He, Ne, Ar, Kr, and Xe.

18. A method of manufacturing a semiconductor device comprising steps of:

adding a metal element to a semiconductor film having an amorphous structure;

crystallizing the semiconductor film having an amorphous structure to form a semiconductor film having a crystalline structure;

forming a first mask on the semiconductor film having a crystalline structure;

selectively adding a rare gas element to the semiconductor film having a crystalline structure to form an impurity region;

gettering the metal element to the impurity region to selectively remove or reduce the metal element in the semiconductor film having a crystalline structure;

forming a second mask on the semiconductor film having a crystalline structure; and

selectively removing the semiconductor film.

19. A method according to claim 18, wherein the impurity region and a part of the semiconductor film having a crystalline structure are removed in the selectively removing the semiconductor film.

20. A method according to claim 18, wherein the second mask is provided at a position on an inner side of the ends of the first mask.

21. A method according to claim 18, wherein one kind or a plurality of kinds of elements selected from the group consisting of H, H<sub>2</sub>, O, O<sub>2</sub>, and P are added in addition to the rare gas element.

22. A method according to claim 18, wherein the selectively adding a rare gas element is conducted in an atmosphere containing a rare gas element and water vapor.

5 23. A method according to claim 18, further comprising a step of irradiating the semiconductor film with strong light or laser light from a front surface or a reverse surface to activate the impurity element after the removing the semiconductor film.

24. A method according to claim 18, further comprising a step of oxidizing a  
10 surface of the semiconductor film having a crystalline structure with a solution containing ozone after the crystallizing.

25. A method according to claim 18, wherein the crystallizing is conducted by heat treatment.

15 26. A method according to claim 18, wherein the crystallizing is conducted by irradiation of the semiconductor film having an amorphous structure with strong light.

20 27. A method according to claim 26, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

25 28. A method according to claim 18, wherein the crystallizing is conducted by

heat treatment and irradiation of the semiconductor film having an amorphous structure with strong light.

29. A method according to claim 18, wherein the gettering is conducted by heat  
5 treatment.

30. A method according to claim 18, wherein the gettering is conducted by irradiation of the semiconductor film with strong light.

10 31. A method according to claim 30, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

15 32. A method according to claim 18, wherein the gettering is conducted by heat treatment and irradiation of the semiconductor film with strong light.

20 33. A A method according to claim 18, wherein the metal element is one kind or a plurality of kinds of elements selected from the group consisting of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, Cu, and Au.

34. A method according to claim 18, wherein the rare gas element is one kind or a plurality of kinds of elements selected from He, Ne, Ar, Kr, and Xe.

25 35. A method of manufacturing a semiconductor device comprising steps of:

forming a first mask on a semiconductor film having an amorphous structure;

selectively adding a metal element to the semiconductor film having an amorphous structure;

5 crystallizing the semiconductor film to form a semiconductor film having a crystalline structure;

selectively adding a rare gas element to the semiconductor film having a crystalline structure to form an impurity region;

10 gettering the metal element to the impurity region to selectively remove or reduce the metal element in the semiconductor film having a crystalline structure;

forming a second mask on the semiconductor film having a crystalline structure; and

selectively removing the semiconductor film.

15 36. A method according to claim 35, wherein the impurity region and a part of the semiconductor film having a crystalline structure are removed in the selectively removing the semiconductor film.

37. A method according to claim 35, wherein the second mask is provided at  
20 a position on an inner side of the ends of the first mask.

38. A method according to claim 35, wherein one kind or a plurality of kinds of elements selected from the group consisting of H, H<sub>2</sub>, O, O<sub>2</sub>, and P are added in addition to the rare gas element.

39. A method according to claim 35, wherein the selectively adding a rare gas element is conducted in an atmosphere containing a rare gas element and water vapor.

5 40. A method according to claim 35, further comprising a step of irradiating the semiconductor film with strong light or laser light from a front surface or a reverse surface to activate the impurity element after the removing the semiconductor film.

41. A method according to claim 35, further comprising a step of oxidizing a  
10 surface of the semiconductor film having a crystalline structure with a solution containing ozone after the crystallizing.

42. A method according to claim 35, wherein the crystallizing is conducted by  
heat treatment.

15 43. A method according to claim 35, wherein the crystallizing is conducted by irradiation of the semiconductor film having an amorphous structure with strong light.

20 44. A method according to claim 43, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

25 45. A method according to claim 35, wherein the crystallizing is conducted by



heat treatment and irradiation of the semiconductor film having an amorphous structure with strong light.

46. A method according to claim 35, wherein the gettering is conducted by heat  
5 treatment.

47. A method according to claim 35, wherein the gettering is conducted by  
irradiation of the semiconductor film with strong light.

10 48. A method according to claim 47, wherein the strong light is emitted from  
a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a  
xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure  
mercury lamp.

15 49. A method according to claim 35, wherein the gettering is conducted by heat  
treatment and irradiation of the semiconductor film with strong light.

20 50. A A method according to claim 35, wherein the metal element is one kind  
or a plurality of kinds of elements selected from the group consisting of Fe, Ni, Co, Ru,  
Rh, Pd, Os, Ir, Pt, Cu, and Au.

51. A method according to claim 35, wherein the rare gas element is one kind  
or a plurality of kinds of elements selected from He, Ne, Ar, Kr, and Xe.